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Competition Effects from Patient Mobility in the European Union

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ABSTRACT

This paper studies the effects of reimbursement for medical tourism within the European Union. We use a spatial competition framework to study the effects on prices, qualities and patient flows between two countries. Patient mobility increases with the implementation of reimbursement mechanisms. The resulting equilibria in prices and qualities depend on the rule of reimbursements and possible differences in country specific parameters. Soft budget constraints that public providers may have, pose a competitive advantage over private providers and divert demand toward the former. Supranational coordination concerning soft budgets constraints is needed to address the potentially detrimental effects on aggregate welfare.

Keywords: Cross-border Directive, Soft budgets, Patient mobility, Quality competition

1 Introduction

Medical tourism describes the situation in which an individual travels outside his country of residence with the purpose of receiving medical treatment. According to the Commission of the European Communities (2006), total costs of cross-border care within the European Union, including unplanned treatments, amount to circa one percent (€10bn) of public spending on healthcare.[1] Council Directive 2011/24/EU on the application of patients' rights in cross-border healthcare (in the following: the Directive) aims to "improve the functioning of the internal market and the free movement of goods, persons and services [in the domain of healthcare]."[2] The Directive clearly defines the entitlements to reimbursement for planned healthcare in EU Member states outside the state of affiliation. It also makes the requirement of prior authorisation for treatments the exception rather than the rule.[3] In the light of these circumstances this paper analyses the effects of the Directive on qualities and prices of healthcare in EU Member States and the arising patient mobility when different rules of reimbursement for cross-border care apply.

With entry into force, patients that are entitled to a particular treatment in their country of affiliation are likewise eligible to receive reimbursement up to the cost of that particular treatment when seeking treatment in another EU member state. Each member state is required to establish a national contact point for cross-border care that provides outgoing patients with information about their entitlements and incoming patients about national quality and safety standards. Healthcare providers are obliged to inform enquirers on quality and safety standards as well as prices.Insurance providers or public authorities respectively must clearly state the full range of benefits and terms of reimbursement. Unlike EU-regulation that had already been in place prior to the Directive, the latter applies to all

[1] There is no more recent and convincing data on the scale of planned cross-border care. The reason for that is because data is collected at a national level and many agencies do not differentiate between planned and unplanned care during the process of data collection and creation.

[2] OJ L88, 4.4.2011, p. 45

[3] Member States are allowed to introduce a system of prior authorisation for inpatient care, for highly specialised and cost-intense healthcare and in specific cases relating to quality or safety by the particular provider in question (OJ L88/45, 4.4.2011, p. 59).

healthcare providers in the EU. For the abovementioned reasons patient mobility is expected to increase over the next few years since EU member countries had to implement national law that is in line with the Directive by the end of 2013.

The details on how and at what level the transfers for reimbursement shall be made are not further specified in the Directive and were left to be worked out by Member States. In this work reimbursement is implemented at the patient-level allowing to draw direct inferences on the change of patients' incentives and the resulting behaviour. Costs for medical treatments are usually (partially) covered by some form of insurance such that the price at the point of provision the patient has to bear does not reflect the full cost of treatment. The status-quo prior to the implementation of the Directive (PRE[4]) is assumed to not provide for any sort of reimbursement for planned healthcare abroad.[5] We will consider two different possibilities of reimbursing patients. The first (POST) is a fixed copayment rate in which the patient is reimbursed the part of the (assumed) cost that his insurance would have covered if the patient underwent treatment in his home country. This scenario probably constitutes the most straightforward interpretation of the conditions on reimbursement as they are set out in the Directive. The second reimbursement scheme is considered for possible policy implications. Patients are reimbursed with a fixed rate (FRR) on the total costs of treatment independent of where the treatment was performed.

Irrespective of the scenario we find a tendency that is driven by supply-side cost sharing to provide quality above the aggregate welfare maximising level. Mobility prior to the implementation of the Directive is low as cost sharing is only available for treatments in the patients' home country. The resulting differences in net prices soften price competition between providers and limit mobility. The implementation of the Directive leads to an increase in mobility as reimbursement for treatment abroad acts like domestic cost sharing and decreases the relative net price difference to patients. The rule on which re-

[4]The abbreviations PRE, POST and FRR will be used throughout this work to refer to the corresponding situation as they are outlined in this section.

[5]This is not entirely true as the cases of cases of Kohl ([1998] 158 C 96 (ECR)) and Decker ([1998] 120 C 95 (ECR)) illustrate. The Directive originates from a legislative void that the case law rulings created. Nonetheless, we consider the assumption of zero reimbursement to serve as a benchmark to clearly illustrate the effects and not to reflect absolute values.

imbursement is based on determines the degree of price and quality competition between providers. In POST, price competition between providers is intensified, leading to lower prices and levels of quality. Providers' profits decrease but patients' benefits increase. The opposite holds true in FRR. Looking at competition between private and public providers we conclude that the latter holds a competitive advantage diverting demand toward its direction. Having one provider operate under a soft budget constraint may be beneficial to overall welfare due to the increased benefits from higher qualities to that provider's patients. Each country has incentives to introduce soft budget constraints, but bilateral introduction harms aggregate welfare compared to the situation with hard budget constraints. Furthermore, unilateral introduction of soft budgets causes a bias in quality and welfare between countries. Patients that are treated by the provider that operates under the hard budget constraint are worse off as that provider offers lower levels of quality. In order to avoid a potentially welfare decreasing situation in which policy makers end up in a prisoner's dilemma when having to decide on whether or not to allow soft budgets, public providers should also be put under a hard budget constraint. If the public provider operates under a global budget its decisions greatly depend on the amount it obtains for treatments. In POST this pushes demand toward the private provider, while it attracts demand under FRR. Allowing the public provider to price discriminate against potential patients from abroad benefits domestic patients when price competition is soft and may harm them when price competition is stiff. When price competition is soft, qualities are the main tool to compete with for patients. As qualities are common to the type of patient domestic patients benefit from higher qualities at a constant price.

The remainder of this paper is organised as follows. The next section places this work in context with existing literature, before the model is introduced in Section 3. The model is then analysed for the cases of price competition (Section 4), optimal qualities (Section 5) and price and quality competition (Section 6). Section 7 analyses the implications of competition between public and private providers, before Section 8 provides concluding remarks.

2 Literature Review

There exist a wide array of literature on spatial competition models that feature aspects of vertical and horizontal differentiation employing a setting à la Hotelling (1929). Ma and Burgess (1993) were one of the first to use this framework to analyse the interdependencies between price and quality decisions in the domain of healthcare. They argue that levels of quality provision are below the social optimum as pricing decisions tend to undercut additional profits from attracting patients by offering higher qualities. The same strategic effects of quality are present in this paper but cost-sharing between patients and an exogenous insurance provider leads to excess provision of quality compared to the social optimum. The setup they employ is able to draw preliminary inferences on equilibrium behaviour of firms but is mainly focused on supply-side aspects.

Other literature extended their framework to analyse inter-regional competition in markets for healthcare provision. However, to the knowledge of the author, none of these works would allow simultaneous flows of patients between regions (countries). Typically, the focus lies on the effects of a difference in supply-side factors, that (mostly) result in a one-sided diversion of demand toward one of the providers (e.g. Aiura 2013).

Brekke et al. (2014) address the same Directive as this work but focus on policy aspects rather than competition effects. Policy makers of each region, that differ in their costs of quality provision, decide on qualities and tax levels to finance expenditures while medical treatment is free at the point of use. Their work analyses the effect of different transfer payment schemes between regions on financing, welfare and patient flows. Their approach is not suitable to answer questions regarding the effects on competition and resulting mobility. To be able to infer on equilibrium behavior that stems from the implementation of reimbursement for medical tourism, it requires that patients do not have to bear the full cost of domestic treatment in first place as the resulting equilibria when reimbursement is present or not would otherwise only depend on patients' price reservation values. Similar to Barros and Martinez-Giralt (2002) we introduce copayment schemes

that cover parts of the expenses for domestic treatments. To allow for simultaneous patient flows between countries we will need to introduce a second line segment.

3 Model

Consider the market for the provision of medical care in two different EU member states (A and B) each represented by a linear segment $L_i = [0,1], i \in \{a,b\}$. In each country there exist a single healthcare provider. The provider of country A is located at the left endpoint whereas the provider of country B is located at the right endpoint of the segments. Customers (patients) are uniformly distributed on the segment lines with a total mass per segment normalized to 1 and each patient demands one unit of healthcare per episode. Patients have an insurance contract (y, s_i), where $s_i \in [0,1]$ is the patients' copayment rate and can be interpreted as the demand-side cost-sharing (Ellis and McGuire, 1993). The insurance contributes with $(1-s_i)$ to the cost of treatment. Insurance is mandatory and insurance costs y are sunk at this time. Utility of a patient residing in country A located at x_a is given by the following two terms when seeking treatment domestic or abroad:

$$V(A,x_a) = v + q_a - s_a p_a - \tau x_a; \qquad V(B,x_a) = v + q_b - p_b + \omega_a - (1-\tau)x_a$$

And analogous for residents of country B located at x_b:

$$V(A,x_b) = v + q_a - p_a + \omega_b - \tau x_b; \qquad V(B,x_b) = v + q_b - s_b p_b - (1-\tau)x_b,$$

where $v > 0$ is the gross patient surplus, q_i is the level of quality offered by provider i, p_i is the price charged by provider i, s_i is the patient's coinsurance rate in case of domestic treatment and ω_i is the reimbursement payment in case of treatment abroad.[6] τ is the marginal disutility of traveling and can also be interpreted as the inverse of the degree of competition between providers. v is assumed to be large enough to ensure full market coverage. The assumptions $\omega_a < p_b$ and $\omega_b < p_a$ are required for consistency and as

[6]The assumption that patients' gross surplus might differ depending on the country of treatment (e.g. it may be greater at home than abroad due to cultural preferences) only affects the position of the indifferent consumers. This possibility is not further elaborated as it only changes the magnitude of effects but does not affect the qualitative results derived in this work.

to prevent arbitrage possibilities in line with the Directive. A lower bound on quality in compliance with EU norms is normalised to zero. Reimbursement will vary according to different schemes as depicted in the first section:

I) No reimbursement: $\omega_i = 0$ (PRE)

II) Fixed copayment rate : $\omega_i = (1 - s_i)p_i$ (POST)

III) Fixed reimbursement rate : $\omega_i = (1 - s_i)p_j, i \neq j$ (FRR)

We define $\eta = (1-\alpha-\beta)(1+s_a) + 2\alpha + \beta(s_a+s_b)$ and $\psi = (1-\gamma-\delta)(1+s_b) + 2\delta + \gamma(s_a+s_b)$; $\alpha, \beta, \gamma, \delta \in \{0,1\}, \alpha+\beta \leq 1, \gamma+\delta \leq 1$. Table 1 displays the parameter settings that correspond to each specific scenario of reimbursement. The resident of country i that is indifferent between seeking treatment domestic or abroad is located at $V(a,\tilde{x}_i) = V(b,\tilde{x}_i)$. It follows that:

$$\tilde{x}_a = \tfrac{1}{2} + \tfrac{q_a - q_b}{2\tau} + \tfrac{p_b - s_a p_a - \omega_a}{2\tau}; \qquad \tilde{x}_b = \tfrac{1}{2} + \tfrac{q_a - q_b}{2\tau} + \tfrac{s_b p_b - p_a + \omega_b}{2\tau}. \tag{1}$$

Residents located left to the indifferent consumer seek treatment at provider A, while those situated right of it consult provider B. Hence, demands for providers are given by $D_a = \tilde{x}_a + \tilde{x}_b$ and $D_b = (2 - \tilde{x}_a - \tilde{x}_b)$, respectively.

Table 1: Parameters values defining reimbursement scenarios

		ω_a	ω_b
PRE	$\alpha = \beta = \gamma = \delta = 0$	0	0
POST	$\alpha = \delta = 1, \beta = \gamma = 0$	$(1-s_a)p_a$	$(1-s_b)p_b$
FRR	$\beta = \gamma = 1, \alpha = \delta = 0$	$(1-s_a)p_b$	$(1-s_b)p_a$

4 Price Competition

Assuming levels of quality as equal and given by $q_i = \overline{q}$ and marginal cost of healthcare provision equal to zero, the indifferent consumers are located at:

$$\tilde{x}_a = \tfrac{1}{2} + \tfrac{p_b - s_a p_a - \omega_a}{2\tau}; \qquad \tilde{x}_b = \tfrac{1}{2} + \tfrac{s_b p_b - p_a + \omega_b}{2\tau},$$

while providers' profits are given by: $\pi_a = (\tilde{x}_a + \tilde{x}_b)\, p_a$ and $\pi_b = (2 - \tilde{x}_a - \tilde{x}_b)\, p_b$. Differentiating the profit functions with respect to prices and solving the set of first order conditions we obtain optimal prices:

$$p_a^* = 2\tau\eta^{-1}; \qquad p_b^* = 2\tau\psi^{-1}.$$

Table 2 displays prices, profits and indifferent consumers for all considered scenarios.[7] For either country prices and profits under different reimbursement rules are ranked in descending order: FRR >PRE >POST $\forall s_i \in (0,1)\,, i \in \{a,b\}$.

Without financial support for being treated outside the country of residence no mobility occurs for equal coinsurance rates when patients have to bear less than a third of treatment costs.[8] Domestic prices are independent from foreign coinsurance rates as long as reimbursement is not defined in terms of foreign prices as in FRR. The marginal effect of an increase in patients' coinsurance rate on countries' total costs, constituted of insurer's and insurees' expenditures, is strictly negative ($-\frac{3-s_i}{(1+s_i)^3}\,\tau$).[9] While the marginal effect on total expenditures of patients is positive, as $\frac{\partial p_i}{\partial s_i} \leq 0$ but $\frac{\partial (p_i s_i)}{\partial s_i} \geq 0$, the decrease in costs of the insurer due to lower prices and less domestic treatments outweighs the increase in patients' costs. Higher coinsurance rates stiffen price competition.

Table 2: Prices, profits and indifferent consumers under different schemes

	Prices	Profits	Indifferent Consumers
PRE	$p_a = \frac{2}{1+s_a}\tau, p_b = \frac{2}{1+s_b}\tau$	$\pi_a = \frac{2}{1+s_a}\tau, \pi_b = \frac{2}{1+s_b}\tau$	$\tilde{x}_a = \frac{1}{2} + \frac{1}{1+s_b} - \frac{s_a}{1+s_a}$, $\tilde{x}_b = \frac{1}{2} + \frac{s_b}{1+s_b} - \frac{1}{1+s_a}$
POST	$p_a = p_b = \tau$	$\pi_a = \pi_b = \tau$	$\tilde{x}_a = \tilde{x}_b = \frac{1}{2}$
FRR	$p_a = p_b = \frac{2}{s_a+s_b}\tau$	$\pi_a = \pi_b = \frac{2}{s_a+s_b}\tau$	$\tilde{x}_a = \tilde{x}_b = \frac{1}{2}$

[7] Holds true for indifferent consumers in the pre-directive scenario only for $3\,s_b\,s_a + s_a + s_b \geq 1$. If this condition is not met $\tilde{x}_a = 1$ and $\tilde{x}_b = 0$ what equals a situation without mobility.

[8] According to a study of the European Parliament, dental care put aside, patients' coinsurance rates in the EU on average usually don't exceed 20%. Dental care is one of the areas where medical tourism is already more active in Europe, giving support to this observation.

[9] Insurance costs are given by $TCI_a = (1 - s_a) \cdot p_a \cdot \tilde{x}_a$ and $TCI_b = (1 - s_b) \cdot p_b \cdot (1 - \tilde{x}_b)$ respectively.

When at least one country introduces a regime of fixed copayments to its residents, patient mobility in both countries is increased. Under such regime the domestic provider has incentives to lower prices for two reasons. Firstly, a lower domestic price retains some domestic patients while it attracts more foreign patients. Secondly, as reimbursement is expressed as a fraction of the domestic price, monetary incentives for being treated abroad diminish. If reimbursement was introduced unilaterally the provider in the country where no such mechanism exists would keep prices unchanged. The outflow of domestic patients that are lost as a result of the lower prices abroad are matched with an inflow of foreign patients. The latter are attracted due to the availability of copayments for treatments abroad that reduces their net price. Mobility is increased in both directions, leading -from a patient's view- to a pareto-superior outcome. The reasoning for lowering prices applies to both providers when fixed co-payments are in place in both countries (POST) as providers cannot coordinate on higher prices. This results in a situation in which both providers serve half of each country's market and yields the largest mobility in the considered scenarios.

While a fixed reimbursement rate leads to the same degree of mobility, prices and private profits are the highest of all scenarios. Adjusting one's own prices has no direct effect on the absolute amount of domestic patients' reimbursement for seeking care abroad. A price increase renders treatments less attractive to all patients. However, patients only have to pay the same proportion of prices independent from the place of treatment. Therefore higher foreign nominal prices do not translate equally into larger net prices to the patients. This attracts a sufficient amount of foreign patients to offset the foregone profits due to an outflow of domestic patients. Price competition is relaxed when both providers operate under such regime; enabling them to charge substantially higher prices compared to the situation without reimbursements. Hence, the regime of fixed copayment is preferred to the fixed reimbursement rate when having to decide based on prices only.

Price Discrimination and Welfare

Article 4 of the Directive stipulates non-discrimination with regard to nationality and requires providers to apply the same scale of fees to both domestic and foreign patients.[10] Assume for this section that providers may engage in third-degree price discrimination according to country of origin. Denote p_{ij} the price provider i charges patients of country j, $(i, j) \in \{A, B\}$. Further assume that patients must be reimbursed based on the prices that are available to them when choosing between providers. To evaluate the effect of price discrimination under the different scenarios define national welfare as the sum of provider's profits, residents' utility from treatment and total costs of healthcare. Refer to Appendix A for a formal definition of the welfare functions, the adjusted optimisation problems and the resulting equilibria. Differences in eligibility for coinsurance translate into different demand elasticities for treatments abroad and at home. Providers charge a lower price to the group with the more elastic demand, namely foreign patients. In PRE foreign patients benefit from lower prices while prices for domestic treatment are higher. The aggregate effect on consumer welfare is positive as the increased price competition for foreign patients induces mobility and minimises transportation costs. Overall welfare is always at least as high when allowing price discrimination in the case where equal coinsurance rates apply in both countries. In FRR welfare is higher in the country with the higher coinsurance rate as a higher coinsurance rate, ceteris paribus, stiffens price competition and leads to lower prices for residents of that country. Under the specifications in this section price discrimination leads to an outcome that satisfies the Kaldor–Hicks efficiency criterion.

5 Quality

In this section we establish the national and supranational optimal levels of quality assuming that national welfare is defined by the sum of its population's utility and provider's profits deducted by the domestic insurance's copayments. Sticking to the assumption that

[10] OJ L88, 4.4.2011, p. 56

marginal costs of provision are constant and equal to zero we specify the cost function of quality provision to take the commonly used (e.g. Brekke, Siciliani and Straume (2012)) quadratic form $C_i(q_i) = \frac{\theta_i}{2}{q_i}^2$, where θ_i is a technology parameter. Unless specified otherwise we will assume technology parameters to be equal in both countries ($\theta_a = \theta_b$) for the remainder of this paper. Welfare for a given country is then described as follows:

$$W_A = \int_0^{x_a}(v+q_a-\tau x_a)\mathrm{d}x_a + \int_{x_a}^{1}(v+q_b-p_b-\tau(1-x_a))\mathrm{d}x_a + \int_0^{x_b}(p_a)\mathrm{d}x_b - \frac{\theta_a}{2}{q_a}^2 \quad (2)$$

$$W_B = \int_0^{x_b}(v+q_a-p_a-\tau x_b)\mathrm{d}x_b + \int_{x_b}^{1}(v+q_b-\tau(1-x_b))\mathrm{d}x_b + \int_{x_a}^{1}(p_b)\mathrm{d}x_a - \frac{\theta_b}{2}{q_b}^2 \quad (3)$$

Profits that are generated from domestic patients do not add to national welfare as they create no value. Providers' contribution to welfare is therefore limited to profits from treating foreign patients and quality provision. National welfare is strictly increasing in the former, and strictly decreasing in foregone profits and payments to the foreign provider that result from outbound patient mobility. Thus there exists a bias toward less outbound and more inbound mobility compared to aggregate welfare as this definition of national welfare gives a larger weight to profits than consumer welfare. Establishing conditions for supranational collaboration in welfare optimisation is beyond the scope of this paper.[11]

Due to the strict relationship between prices and national welfare consider the vector (x_i, q_i) that maximises national welfare in country i. The set of first order conditions is given by:

$$\frac{\partial W_A}{\partial x_a} = q_a - q_b + p_b - 4x_a\tau + 2\tau = 0, \quad (4)$$

$$\frac{\partial W_B}{\partial x_b} = q_a - q_b - p_a - 4x_b\tau + 2\tau = 0, \quad (5)$$

$$\frac{\partial W_A}{\partial q_a} = x_a - \theta_a q_a = 0, \quad (6)$$

$$\frac{\partial W_B}{\partial q_b} = (1-x_b) - \theta_b q_b = 0. \quad (7)$$

From equations (4) and (5) it follows:

[11] The interested reader may refer to (Brekke et al., 2014) who analyse possibilities for transfer policies in a similar context.

$$x_a = \frac{1}{2} + \frac{q_a - q_b + p_b}{4\tau}; \qquad 1 - x_b = \frac{1}{2} + \frac{q_b - q_a + p_a}{4\tau},$$

Looking at the resulting first-best demand share of the local market and (6) and (7) we take note of the fact that from an isolated perspective national quality levels and market shares exceeding those of the integrated outcome are desirable.

With a supranational utilitarian approach equity is no concern and the optimal location of the indifferent consumer is given by: $\tilde{x}_i = \frac{1}{2} + \frac{q_a - q_b}{4\tau}$. First-best levels of quality are obtained by substituting $\tilde{x}_i$ into (6) and (7) and yield: $q_i = \frac{1}{2\theta_i}$. For equal technology parameters, the symmetry implies that the indifferent consumers shall be located equidistant from the endpoints in order to minimise total transporation costs. When technologies differ the provider with lower costs of quality provision (smaller θ_i) should provide a higher level of quality than its competitor and serve more than half of each population.

6 Price and Quality Competition

This section analyses the effects of the Directive when providers compete in prices and qualities. We will look at the situation in which providers choose both prices and qualities simultaneously and the situation in which they set quality levels before deciding on prices. Within the range of the Directive the sequential setting is the more relevant one as it more accurately describes not easily reversible investments in cost-intense long-term equipment as it is more common in the secondary and tertiary levels of care.

6.1 Simultaneous Decisions

Profits are by definition the difference between revenues and costs:

$$\pi_a = (\tilde{x}_a + \tilde{x}_b)\, p_a - \frac{\theta_a}{2} {q_a}^2; \qquad \pi_b = (2 - \tilde{x}_a - \tilde{x}_b)\, p_b - \frac{\theta_b}{2} {q_b}^2. \tag{8}$$

Indifferent consumers are given by equation (1). From the first order conditions for profit maximisation with respect to prices and qualities, it follows that optimal prices and qual-

ities are given by the following best-response correspondences:[12]

$$p_a = 2(\frac{q_a - q_b}{3} + \tau)\eta^{-1}, \tag{9}$$

$$p_b = 2(\frac{q_b - q_a}{3} + \tau)\psi^{-1}, \tag{10}$$

$$\theta_a q_a = \frac{2}{3}(\frac{q_a - q_b + 3\tau}{\tau})\eta^{-1}, \tag{11}$$

$$\theta_b q_b = \frac{2}{3}(\frac{q_b - q_a + 3\tau}{\tau})\psi^{-1}. \tag{12}$$

Figure 1 displays the three resulting symmetric equilibria. Without any reimbursement mechanism in place qualities and prices are higher in the country where patients' coinsurance rate is lower. Higher coinsurance rates, ceteris paribus, soften price competition as domestic treatments become relatively more expensive compared to undergoing treatment abroad. Providers react with an increase in quality to attract and retain patients as quality levels are the predominant tool to compete with under relaxed price competition. The zero reimbursement scheme has the lowest potential to induce patient mobility. However, for abovementioned reasons mobility increases the lower the coinsurance rates are.

For the case of fixed copayment rates, quality and price levels are equal in both countries amounting to $q_a = q_b = \frac{1}{\theta}$ and $p_a = p_b = \tau$ for equal technology. Price but also quality levels are the lowest of all scenarios considered. For the same reasons as in the pure price competition game providers decrease prices compared to the scenario of no reimbursement. Accordingly, attracting patients via the quality instrument becomes less profitable the lower the prices are. This results in a quality decrease in comparison to the scenario of no reimbursement. Patients that sought treatment abroad prior to the implementation of reimbursement benefit the most. Patients in the immediate vicinity of providers are worse off. The aggregate effect on consumer welfare is positive and total transporation costs are minimized as providers serve half of each country's population. This feature is shared under the fixed reimbursement rate but at higher prices and quality levels. The rationale behind the price increase is the same as in the section about price competition. As higher prices translate into higher net profits per patient under the assumption of constant

[12]Refer to Appendix B for the set of first order conditions.

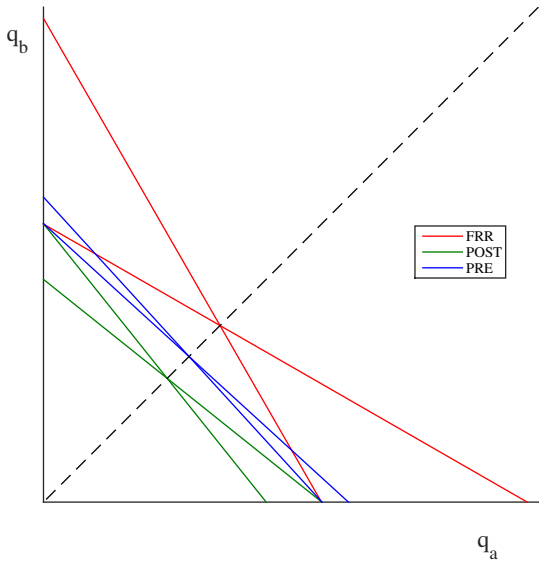

Figure 1: Symmetric equilibrium choice of qualities

marginal costs providers compete for patients by investing in quality. When a provider can produce quality more efficiently (smaller θ_i) that provider will offer a higher level of quality and charge higher prices than his counterpart. That provider attracts more patients in each scenario and satisfies more than half the demand when one of the reimbursement mechanisms is installed. In the latter cases this is independent of coinsurance rates.

While the supranational first-best allocation of patients is achieved when introducing the same reimbursement scheme in both countries quality is too high in all of the above scenarios. Even under the system of fixed copayments the realised quality levels are twice as large as the first best level. The problem of excess quality arises as both providers face the same private incentives for increasing their profits by attracting additional patients via the quality mechanism. A unilateral introduction of fixed copayments would lead to a higher level of quality in the country that does not offer reimbursement to its residents and we can expect total costs of healthcare to be higher in this case.

6.2 Sequential Decisions

In the first stage of the sequential decision game providers simultaneously and independently choose qualities q_i. After having observed the decision on qualities providers si-

multaneously and independently decide on prices p_i. Solving by backward induction with price correspondences already given by (9) and (10) we obtain:

$$q_a\theta_a = \frac{4}{9\eta}\left(\frac{q_a - q_b + 3\tau}{\tau}\right) \tag{13}$$

$$q_b\theta_b = \frac{4}{9\psi}\left(\frac{q_b - q_a + 3\tau}{\tau}\right) \tag{14}$$

Without further computation it is apparent that quality levels are lower than in the simultaneous decision game. The ranking established in the simultaneous game persists. The problem of excess quality remains but is alleviated, e.g. quality levels in case of fixed copayments only exceed the optimal ones by one third. Potential differences in coinsurance rates and technologies between countries do not translate into as big differences in the provided levels of quality as in the simultaneous game. Ceteris paribus, price differences are not as pronounced and consequently mobility is less responsive to differences in country specific characteristics.

7 Soft Budget

Until now we have assumed that both providers are private firms and did not consider the possibility that one of the providers is a statutory corporation. As a proxy for competition between private and public providers we will model the public provider to operate under a soft budget constraint. Similar to Brekke, Siciliani and Straume (2015) and Wright (2015) this is attained by adding a positive probability of "bail out" in case of negative profits. With probability $\lambda > 0$ a cost shock increases the marginal cost of healthcare provision proportionally to providers' prices by $\Delta c = k\,p_i$, with $k > 1$. Sticking to the assumption of zero marginal cost of provision, providers' price-cost margins are given as follows:

$$(p_i - c) = \begin{cases} (p_i - 0) = p_i > 0 & \text{with probability} \quad (1-\lambda) \\ (p_i - \Delta c) = (1-k)\,p_i < 0 & \text{with probability} \quad \lambda \end{cases} \tag{15}$$

Providers incur losses when the shock occurs. With probability $1 > b > 0$ the public provider is bailed out by its national government and the losses are matched. There is no such support for the private provider. All price and quality decisions are made prior to the realisation of the shock and are therefore not state dependent. We assume $\lambda \leq \frac{1}{k}$ to obtain equilibria for which the private provider voluntarily offers nonnegative levels of quality. Assume that provider A is the public provider. Providers are risk neutral and maximise expected profits:

$$\begin{aligned} \pi_a &= \lambda\left(\tilde{x}_a + \tilde{x}_b\right)(1-k)(1-b)\,p_a + (1-\lambda)\left(\tilde{x}_a + \tilde{x}_b\right)p_a - \tfrac{\theta_a}{2}{q_a}^2 \\ \pi_b &= \lambda\left(2 - \tilde{x}_a - \tilde{x}_b\right)(1-k)\,p_b + (1-\lambda)\left(2 - \tilde{x}_a - \tilde{x}_b\right)p_b - \tfrac{\theta_b}{2}{q_b}^2 \end{aligned} \tag{16}$$

7.1 Price Equilibrium under Soft Budget Constraints

Price correspondences are again given by equations (9) and (10). Differentiating the above profit functions with respect to qualities yields:

$$\frac{\partial \pi_a}{\partial q_a} = \frac{p_a}{\tau}R_a - q_a\theta_a = 0, \qquad \frac{\partial \pi_b}{\partial q_b} = \frac{p_b}{\tau}R_b - q_b\theta_b = 0, \tag{17}$$

where $R_a = (1 - k\lambda + b\lambda(k-1))$ and $R_b = (1 - k\lambda)$, with $1 > R_a > R_b > 0$, are risk adjustment factors. Substituting the price correspondences in the above equations gives quality correspondences for simultaneous price and quality decisions:

$$\theta_a q_a = \frac{2}{3\eta}\left(\frac{q_a - q_b + 3\tau}{\tau}\right)R_a, \qquad \theta_b q_b = \frac{2}{3\psi}\left(\frac{q_b - q_a + 3\tau}{\tau}\right)R_b. \tag{18}$$

It becomes apparent that the above best correspondences are the same as in the previous section, multiplied by the risk adjustment factors.[13] Some qualitative features emerge quickly. As the public provider only has to bear a fraction of its potential losses in expectancy it can profitably invest in higher quality and consequently charge higher prices than the private counterpart. Ceteris paribus, the soft budget constraint results in a distortion of patient flows toward the public provider in all scenarios. Furthermore, the pri-

[13] This also holds true for the sequential game in which best correspondences are given by (13) multiplied by R_a and (14) by R_b, respectively.

vate provider's competitive (dis)advantages it might have over the public provider due to exogenous factors, such as technology and copayment rates, are (more) less pronounced. This is particularly harmful when the private provider can provide quality more efficiently. The socially optimal levels of quality are unaffected by the possibility of a shock as neither costs, nor consumer welfare depend on the realisation of the state. The realised qualities depend on the probability and the magnitude of the shock and can either be too high or low.

7.2 Global Budget

In many publicly funded systems healthcare is free at the point of use for contributors. Accordingly, foreign patients have to be charged a different price than domestic patients as no comparable price for domestic patients exists. The Directive mandates to calculate a non-discriminatory, objective price for foreign patients in that case.[14]

Suppose that the public provider of country A is granted a fixed sum per episode of treatment for domestic patients, denoted P_a. The exact amount is predetermined and announced before providers decide on qualities and prices. Therefore there exist no asymmetric information between providers.[15] We will first look at the situation in which the fixed price is charged independently from the origin of patients. Equation (17) hence implies fixed levels of quality for provider A. In a second scenario the public provider is free to determine the price it charges to foreign patients. This may be justified as for example national tariffs for reimbursing hospitals that operate under the National Health Services of the United Kingdom might not reflect the pure cost of treatment. Those rates may be inaccurate when applied to foreign patients as they also cover costs for the primary diagnosis that is typically performed before seeking treatment abroad.

7.2.1 Prospective Payment

The public provider is reimbursed with P_a for treating domestic patients and is obliged to charge foreign patients the same amount as price for treatment, denoted p_{ab}. Indifferent

[14] Note that $s_a = 0$ reflects the case of full insurance coverage.

[15] Asymmetric information between providers would have a similar effect as demand uncertainty on the private provider's side.

consumers are defined by:

$$\tilde{x}_a = \frac{1}{2} + \frac{q_a - q_b}{2\tau} + \frac{p_b - s_a P_a - \omega_a}{2\tau}; \qquad \tilde{x}_b = \frac{1}{2} + \frac{q_a - q_b}{2\tau} + \frac{s_b p_b - p_{ab} + \omega_b}{2\tau}. \tag{19}$$

For now we have $P_a = p_{ab}$. Therefore it does not make a difference which of the two prices is used to define reimbursements. Provider B's profit function is equal to the one in equation (16) while provider A's is given by:

$$\pi_a = \lambda\,(\tilde{x}_a P_a + \tilde{x}_b\, p_{ab})\,(1-k)\,(1-b) + (1-\lambda)\,(\tilde{x}_a P_a + \tilde{x}_b p_{ab}) - \frac{\theta_a}{2} {q_a}^2 \tag{20}$$

By differentiating with respect to q_a we obtain provider A's best quality correspondence:

$$\theta_a\, q_a = \frac{P_a + p_{ab}}{2\,\tau} R_a \tag{21}$$

With no leeway to charge different prices to foreigners, provider A's level of quality is independent from provider B's choices. Provider B's optimal pricing decision is then given by:

$$p_b = \frac{\eta}{2\,\psi}\left(\frac{P_a + p_{ab}}{2}\right) + \frac{q_b - q_a + \tau}{\psi} \tag{22}$$

Substituting the above equation into (17) we obtain quality correspondences as follows:

$$\theta_b\, q_b = \left(\frac{\eta}{2\,\psi\,\tau}\left(\frac{P_a + p_{ab}}{2}\right) + \frac{q_b - q_a + t}{\psi\,\tau}\right) R_b \tag{23}$$

While provider A's qualities are not responsive to any strategic choice of provider B the effects on quality levels and mobility are not per se clear. Solving (21) and (23) with $P_a = p_{ab}$ for optimal qualities we obtain:

$$q_b = \frac{P_a(\eta\,\tau\,\theta_a - 2R_a) + 2\,\tau^2\theta_a}{2\,\tau\,\theta_a\,(\psi\,\tau\,\theta_b - R_b)} R_b; \qquad q_a = \frac{P_a}{\tau\,\theta_a} R_a. \tag{24}$$

The private provider's level of quality does not only depend on the amount provider A is reimbursed with but also on the difference in costs of quality provision and the degree of competition between providers (transportation costs). In fact when technology parameters do not differ substantially from one another the private provider will only offer larger

levels of quality for sufficiently small compensation of the public provider.[16] To better understand the behaviour of providers first consider why provider A chooses the same quality levels in each scenario. Assuming that providers do not differ drastically in their ability to produce quality (condition I) and that the regulated price of the public provider is sufficiently high (condition II) provider B will undercut the fixed price of provider A to attract more patients when there is no reimbursement mechanism in place. In order to retain some of the patients provider A has to offer a higher level of quality. As provider B mainly attracts patients by offering lower prices it does not have to compete as heavily in qualities. The same effect occurs when there is a system of fixed copayment rates in place. The public provider wants to lower prices for motives described in the previous section but is not allowed to and thus has to offer higher qualities to create demand for its services. With fixed reimbursement rates in place price competition is dampened and consequently qualities become the main tool to compete with. The condition that reimbursement cannot exceed the domestic price limits the private provider's ability to take full advantage. As the public provider is not free to increase prices it will also keep qualities unchanged. Provider A's strategies are limited to using qualities to compete with. The author is aware that the constant levels of quality provision of the public provider arise with the assumed simple quadratic separable cost function that does not affect marginal costs of provision. When the public provider's payment per treatment is low so is its budget to provide quality. In that case the private provider will offer higher quality levels than the heavily budget constrained public provider.

7.2.2 Price Discrimination and Prospective Payment

As neither costs nor prices are clearly defined in the Directive there exist some leeway in interpreting both terms. This relates to the decision on what prices shall be applied to foreigners and what constitutes the assumed costs when reimbursing residents that were treated abroad. The public provider is still reimbursed with P_a for treating domestic pa-

[16] The conditions are: I: $2R_a\,\psi\,\theta_b - R_b\,\eta\,\theta_a \geq 0$ and II: $0 < p_{aa} < \frac{2R_b\,\tau\,\theta_a}{2R_a\,\psi\,\theta_b - R_b\,\eta\,\theta_a}$. For equal coinsurance rates provider B will only offer higher qualities than provider A when the former's technology to produce quality is approximately more than twice as efficient.

tients but is free to charge a different price p_{ab} to foreign patients. We will consider the possibilities for reimbursing residents of country A based on either of these two prices. Patients of country B will always be reimbursed based on p_{ab} under a regime of FRR.

Recall that $\theta_a q_a = \frac{P_a + p_{ab}}{2\tau} R_a$. Therefore, provider A's level of quality will only be larger compared to the situation in which both its prices are equal and fixed when $p_{ab} > P_a$. We acknowledge that market equilibria do not solely depend on the level of P_a but also on costs of quality provision, transportation costs, coinsurance rates, reimbursement scenarios and risk adjustment factors and the differences in these variables between countries. The following discussion is based on the assumption that P_a was set at a reasonable level in the sense that it does not cause extreme outcomes compared to the unregulated market outcome.[17] All arguments are made on a ceteris paribus basis. Consider the public provider's incentives for setting prices and qualities when no reimbursement is present. The one-sided possibility to price discriminate against foreign patients stiffens price competition for that group. The public provider will compete more aggressively than its private counterpart because lowering the price to foreign patients only affects the position of the domestic marginal consumer by the resulting change in equilibrium values but not the revenue per domestic patient. This results in both providers' prices for residents of country B as well as the overall levels of quality to decrease. The public provider and patients of country B benefit the most. The former is able to increase its profits, while the latter face lower prices but also lower qualities independent from the place of treatment. Residents of country B will on average benefit. The opposite is true for patients of country A. Patients that remain at home are charged the same fixed price at a lower level of quality. The benefits of those that seek treatment abroad due to lower prices is not expected to offset the effect on overall consumer welfare as provider B will not substantially decrease its prices and its qualities are also lower. Mobility between the two countries increases.

With fixed copayment rates the outcome depends on which price constitutes the basis for reimbursement in country A. When reimbursement is based on the local fixed price the

[17] If it was set at a very high level the public provider would generally charge lower prices to foreign patients and vice versa.

public provider's only incentive to lower p_{ab} is to attract foreign demand but not to decrease domestic patients' monetary incentives for being treated abroad. Therefore, the provided levels of quality will be higher. Residents of country A will benefit from the higher quality when being treated at home and from the inability of the public provider to decrease the absolute reimbursement when seeking care abroad. Provider B will decrease prices for reasons outlined in earlier sections. A larger number of residents of country A will seek treatment abroad as the opposite holds true for country B. The overall effect on country A's welfare is ambigious and depends on realised parameter values. However, we can expect consumer welfare to be higher when reimbursement is based on the fixed price. The effect on provider A's profit is ambiguous and depends on the ratio of incoming and outgoing patients as well as the difference between prices charged to the two groups. With fixed reimbursement rates and price discrimination patients of country A enjoy greater levels of quality at a constant price when being treated at home as provider A will raise prices to foreigners resulting in higher levels of quality. Patients of country B are again worse off only enjoying a slight increase in qualities at higher prices.

Operating under a soft budget constraint constitutes a competitive advantage and it alleviates the disadvantage that arise when facing pricing restrictions. As the magnitude of the shock in marginal costs is directly related to providers' pricing decisions it acts like a buffer. A softer (harder) public budget therefore enables the provider to set higher (lower) prices. This becomes more relevant when the intensity of price competition is low (FRR) and less relevant when price competition is fierce (POST).

Summarizing the public provider benefits from being able to price discriminate, ceteris paribus. Residents of that very same country benefit in situations in which reimbursement mechanisms are installed. Vice versa this is detrimental to the private provider's profits and residents' welfare of that country in POST and FRR. From a patient's point of view it is favourable to define reimbursements based on the fixed domestic price to limit the provider's effort of decreasing absolute monetary reimbursement for treatment abroad.

8 Conclusion

This work has focused on patient mobility and the competition effects in the European Union that result from a directive aimed at facilitating patient mobility. In particular, it has analysed how providers respond to different mechanisms of reimbursement at the patient-level. We witness an excess provision of quality compared to the social optimum that is inherent to the model due to cost sharing between patients and external insurance providers. Patient flows between countries increase when entitlements to reimbursement for cross-border are introduced. This paper contributes to the understanding on how quality and price levels depend on the basis by which reimbursement is defined. The Directive does not address this important question in greater detail and it remains unclear whether it was appropriately considered when translating the principles of the Directive into national law. With increasing public deficits and costs in healthcare in Europe the fixed copayment rates constitute the most desireable option as they increase the intensity of price competition between providers. Total costs are the lowest of all considered scenarios while the optimal level of mobility is attained. Fixed reimbursement rates move qualities further away from the social optimum and result in the highest total costs. On the notion of costs, we find that allowing for price discrimination according to the origin of patients increases the price competition for that group, resulting in lower prices to foreign patients and higher overall welfare at the expense of patients that remain in their country of residence for treatment.

In a situation in which private and public providers compete with one another the softer budget constraint of the latter constitutes a competitive advantage. When not restricted in pricing decisions the soft budget diverts demand toward the public provider that translates into higher expected profits at the expense of the private provider. The advantage to the public provider is larger the softer the price competition is. The reimbursement scheme greatly affects the outcome on welfare. In the PRE scenario the effect on national welfare is ambiguous. For a sufficiently high degree of price competition there exist a welfare

maximising positive probability for bailout as it induces inward mobility and increases domestic patients' benefits. If bailout is too likely to occur the public provider harms expected welfare by overinvesting in quality and consequently charging higher prices that increase expected losses. In the POST scenario welfare in both countries may increase when prices are sufficiently low to start with as foregone profits of the private provider are then relatively small compared to possible benefits to patients. When the intensity of price competition is high the resulting qualities will be low. Ceteris paribus, a higher probability of bailout than in PRE will be optimal as inducing quality provision is disproportionately beneficial to welfare for low qualities due to the quadratic nature of the cost function. The softened price competition in FRR results in a higher level of prices and therefore, ceteris paribus, decreases the optimal probability of bailout. Note that the benefit to inbound foreign patients is the highest under this scenario.

From the perspective of national welfare soft budgets are desirable as it enables the local provider to captivate demand and increases the level of quality to domestic patients. When both providers operate under soft budget constraints the added national welfare that results from treating a larger proportion of patients diminishes. Consequently, soft budgets may decrease expected national welfare in both countries. Each country would prefer to operate as sole country with soft budget constraints and we may end up in a prisoner's dilemma in which a unilateral introduction of soft budgets may increase welfare in both countries but soft budgets in both countries decrease welfare. Aggregate consumer welfare in both countries increases when at least one provider operates under a soft budget. However, in the country in which a private provider operates, patients that remain at home for treatment are worse off as the domestic level of quality decreases. When the shock materialises the government of the country with the public provider indirectly subsidises foreign patients. For these reason and the bias in national welfare soft budget constraints pose they should be carefully evaluated on the grounds of equity and efficiency.

The author, of course, is aware that this model is characterised by several simplifying assumptions. There is a number of possible realistic extensions, e.g. increasing marginal

costs dependent on quality; addressing endogenous balanced budgets of third parties; among many other possibilities. However, the author expects the general conclusions on the competition effects between providers to be robust to extensions to the model.

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Appendices

A Price Discrimination and Welfare

Indifferent consumers are located at:

$$\tilde{x}_a = \tfrac{1}{2} + \tfrac{p_{ba} - s_a p_{aa} - \omega_a}{2\tau}; \qquad \tilde{x}_b = \tfrac{1}{2} + \tfrac{s_b p_{bb} - p_{ab} + \omega_b}{2\tau}, \tag{A-1}$$

while providers' profits are given by:

$$\pi_a = \tilde{x}_a p_{aa} + \tilde{x}_b p_{ab}; \qquad \text{and} \qquad \pi_b = (1 - \tilde{x}_a) p_{ba} + (1 - \tilde{x}_b) p_{bb}. \tag{A-2}$$

The notation for ω_i is straightfoward and based on p_{ji}, where (j,i) designate the origin of provider j and patient i. Table A1 contains the resulting equilibria when price discrimination by country of origin is allowed.

Table A1: Prices, profits and indifferent consumers with price discrimination

	Prices	Profits	Indifferent Consumers
PRE	$p_{aa} = \frac{1}{s_a}\tau, p_{ba} = \tau,$ $p_{bb} = \frac{1}{s_b}\tau, p_{ab} = \tau$	$\pi_a = \frac{1+s_a}{2s_a}\tau, \pi_b = \frac{1+s_b}{2s_b}\tau$	$\tilde{x}_a = \tilde{x}_b = \frac{1}{2}$
POST	$p_{aa} = p_{ba} = \tau,$ $p_{bb} = p_{ab} = \tau$	$\pi_a = \pi_b = \tau$	$\tilde{x}_a = \tilde{x}_b = \frac{1}{2}$
FRR	$p_{aa} = p_{ba} = \frac{1}{s_a}\tau,$ $p_{bb} = p_{ab} = \frac{1}{s_b}\tau$	$\pi_a = \pi_b = \frac{s_a+s_b}{2s_a s_b}\tau$	$\tilde{x}_a = \tilde{x}_b = \frac{1}{2}$

A.1 Welfare Functions

$$W_A = \int_0^{x_a} (v - \tau x_a)\mathrm{d}x_a + \int_{x_a}^1 (v - p_b - \tau(1 - x_a))\mathrm{d}x_a + \int_0^{x_b} (p_a)\mathrm{d}x_b, \tag{A-3}$$

$$W_B = \int_0^{x_b} (v - p_a - \tau x_b)\mathrm{d}x_b + \int_{x_b}^1 (v - \tau(1 - x_b))\mathrm{d}x_b + \int_{x_a}^1 (p_b)\mathrm{d}x_a. \tag{A-4}$$

B Price and Quality Competition

The set of first order conditions is given by:

$$\frac{\partial \pi_a}{\partial p_a} = 1 + \frac{p_b \psi - 2 p_a \eta}{2 \tau} + \frac{q_a - q_b}{\tau} = 0, \tag{B-1}$$

$$\frac{\partial \pi_a}{\partial q_a} = \frac{p_a}{\tau} - \theta_a q_a = 0, \tag{B-2}$$

$$\frac{\partial \pi_b}{\partial p_b} = 1 + \frac{p_a \eta - 2 p_b \psi}{2 \tau} + \frac{q_b - q_a}{\tau} = 0, \tag{B-3}$$

$$\frac{\partial \pi_b}{\partial q_b} = \frac{p_b}{\tau} - \theta_b q_b = 0. \tag{B-4}$$